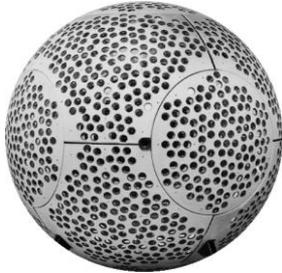




**JC “RESEARCH-AND-PRODUCTION
CORPORATION
“PRECISION SYSTEMS AND INSTRUMENTS”**



Information about “BLITS-M” SC

**The preliminary results of ground tests over the ring CCR
array**

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Stuttgart, 2019



Information about “BLITS-M” launch

BLITS-M (Ball of lens in the space - modernized) retroreflector satellite has been developed and manufactured by the JC "Research and Production Corporation "Precision Systems and Instruments" under the contract with ROSCOSMOS.

The mission purposes are: calibration of the SLR stations, completion of scientific tasks in geophysics, geodynamics and etc.

The "target error" (uncertainty of satellite reference point relative to the CoM position) is less than 0.1mm, and the Earth magnetic field does not affect the satellite orbit and spin parameters.

The reference point of the retroreflector is 110.43 mm behind the sphere center.

The range correction value is 272.522 mm tacking into account the indices of refraction.

Center of the sphere ± 0.05 mm

“BLITS-M” parameters



Inner ball radius R_2	63,987 mm
Inner ball material	TΦ105 (N-SF4)
External layer radius (SC radius) R_1	110,430 mm
External layer material (menisci)	K108 (N-BK7)
SC mass	16,7 kg
Ballistic coefficient	440 kg/m²
The type of orbit	Circumpolar, circular.
The altitude of orbit and inclination	1500 km, 82,5°
SC rotation parameters	Rotation axis is perpendicular to the orbital plane, 10 turns/min
Reflecting coating	Multi-layered, interference
Cross-section	about 1 million. m²
Optical magnitude	11^m – 13^m

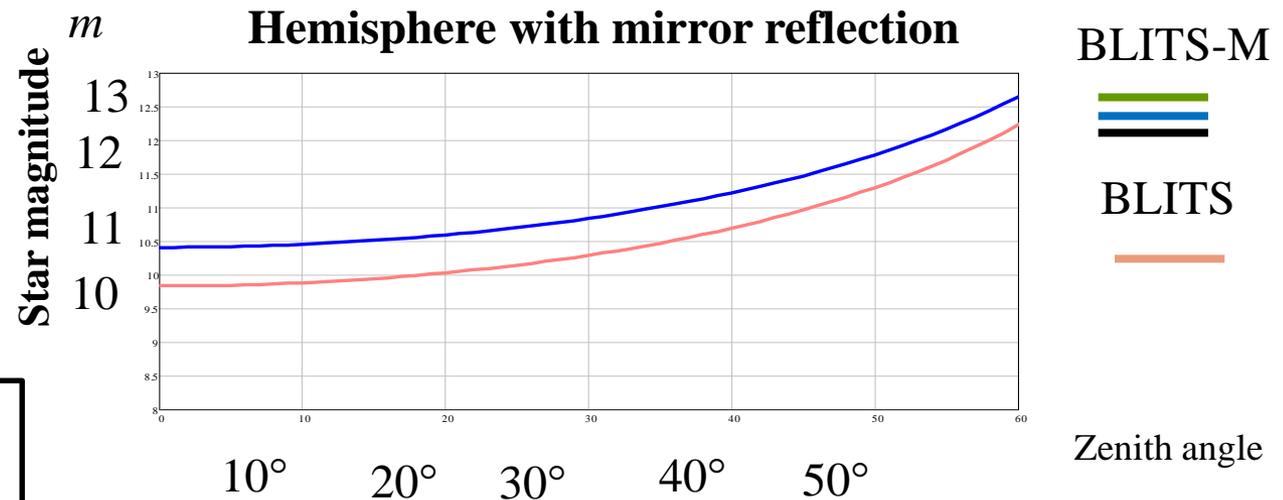
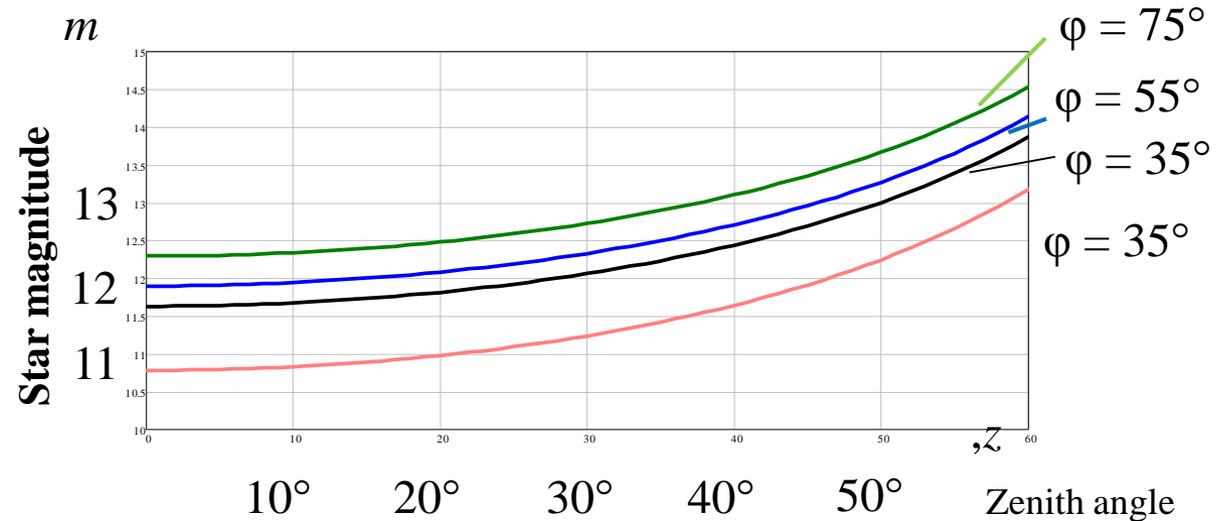


Calculation of star magnitude

taking into account the orbital altitude (850 km and 1500 km)



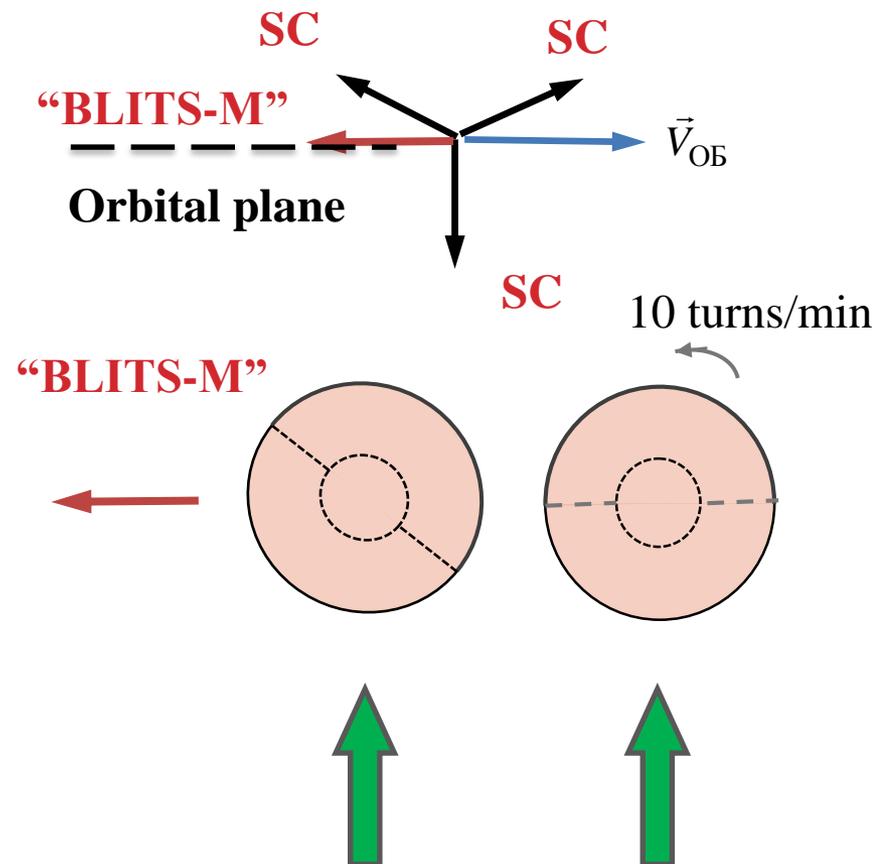
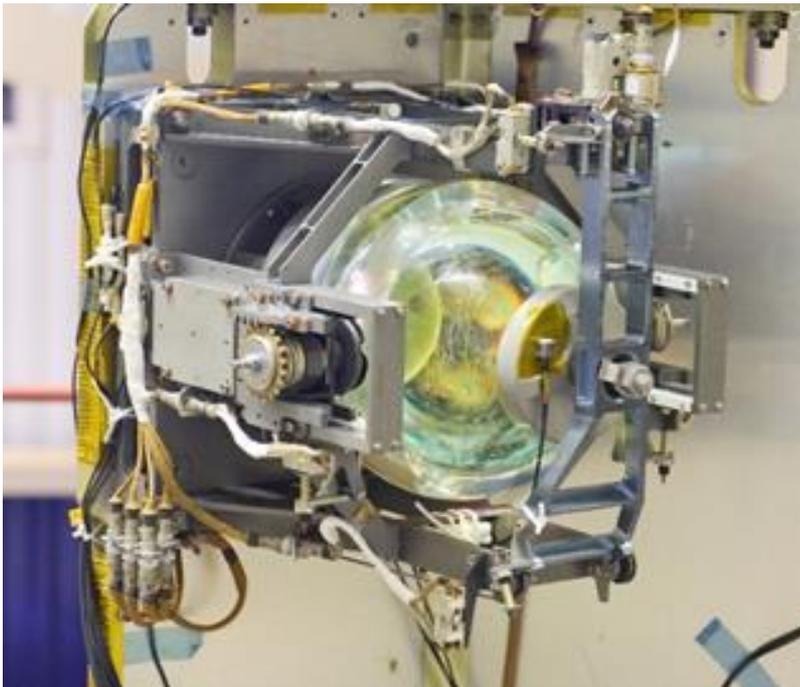
Hemisphere with diffuse reflection



$$m = m_0 - 2.512 \lg \left(\frac{E}{E_0} \right)$$

“BLITS-M” SC separation device

“BLITS-M” SC separation



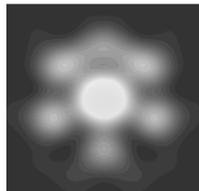


The preliminary results of ground tests over the ring CCR array

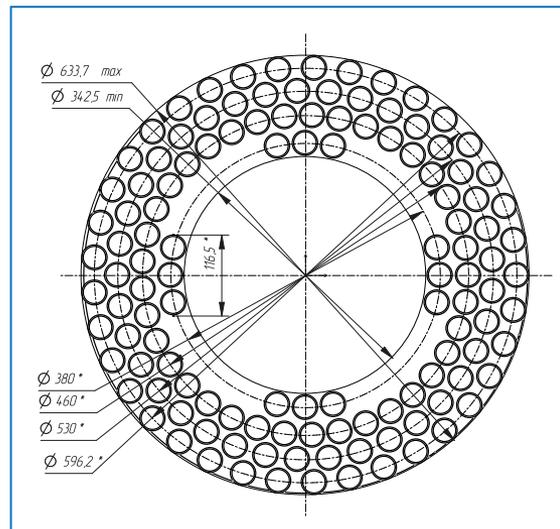
GLONASS-M



112 CCRs.



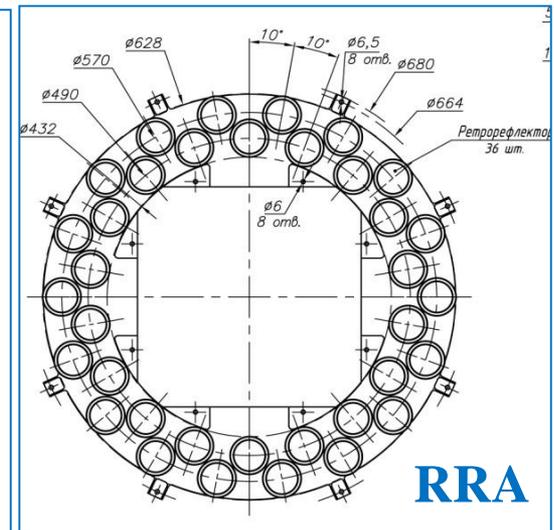
GLONASS-K1



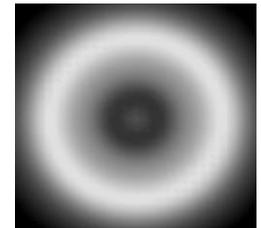
123 CCRs.



GLONASS-K2



36 CCRs.





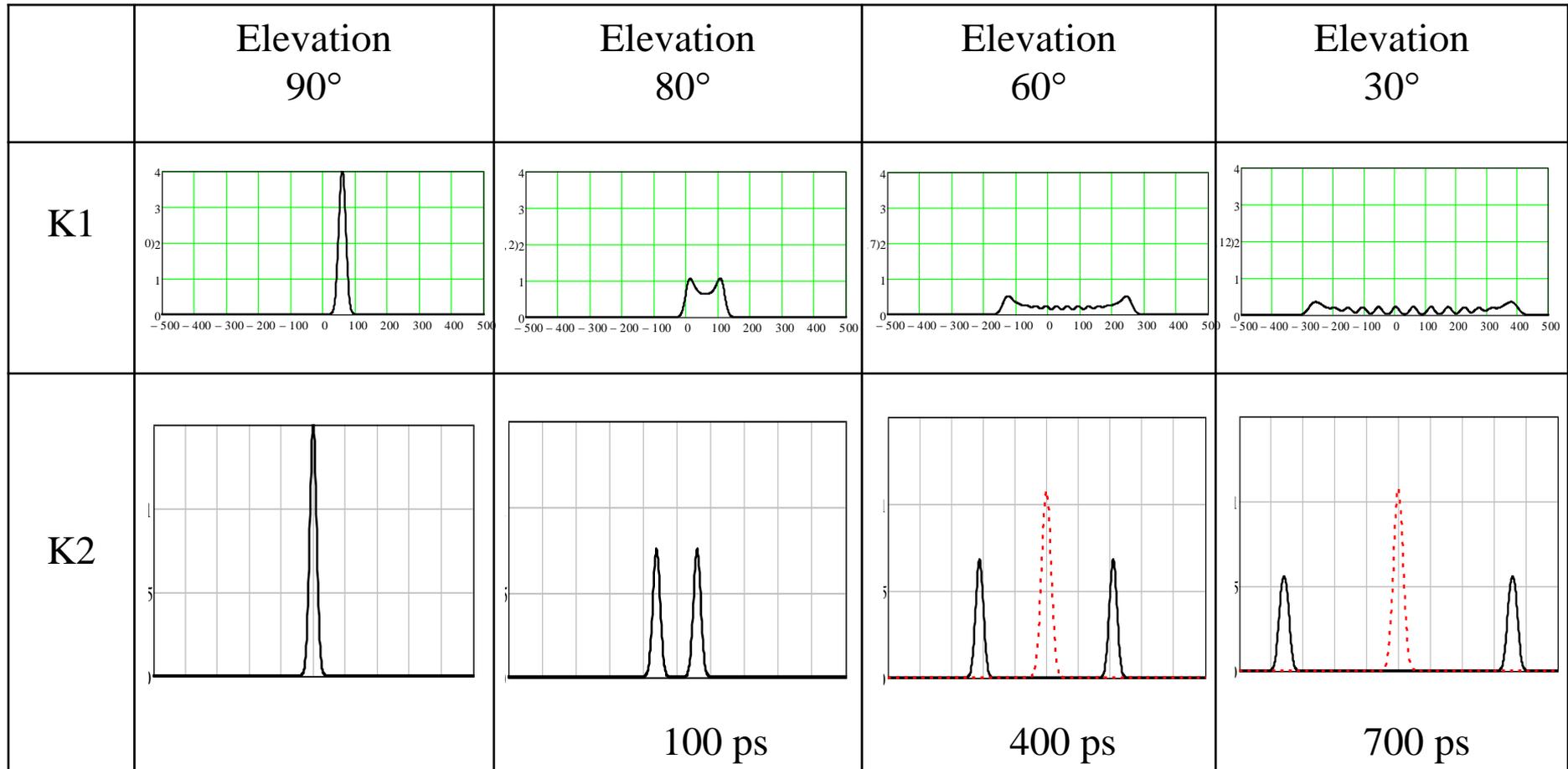
The aim of the retroreflector array modernization for SC “GLONASS-K2”

Time reduction of a normal point formation up to 50 sec. and, thus, the increase of the SLR network productivity by providing the millimeter accuracy of ranging to the center of the RRA

Goal	Technical solution
Increase of the cross-section in 1,5 times up to the value of 180 mln. m ²	Enlarged CCR (the aperture size is 48 mm) with a “two-spot” radiation pattern, oriented by the RRA radius
Ranging error reduction (RMS of a single ranging measurement < 8 mm)	Two separate signals received from two CCR on the opposite sides of RRA
Reduction of the solar heating effect on the RRA characteristics	Interference dielectric coating on the CCR face

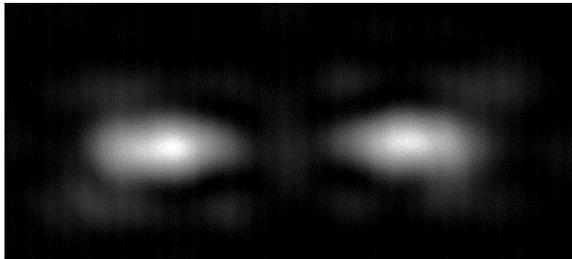


Shapes of the reflected signals of “Glonass-K1” SC and “Glonass-K2” SC flight over the zenith

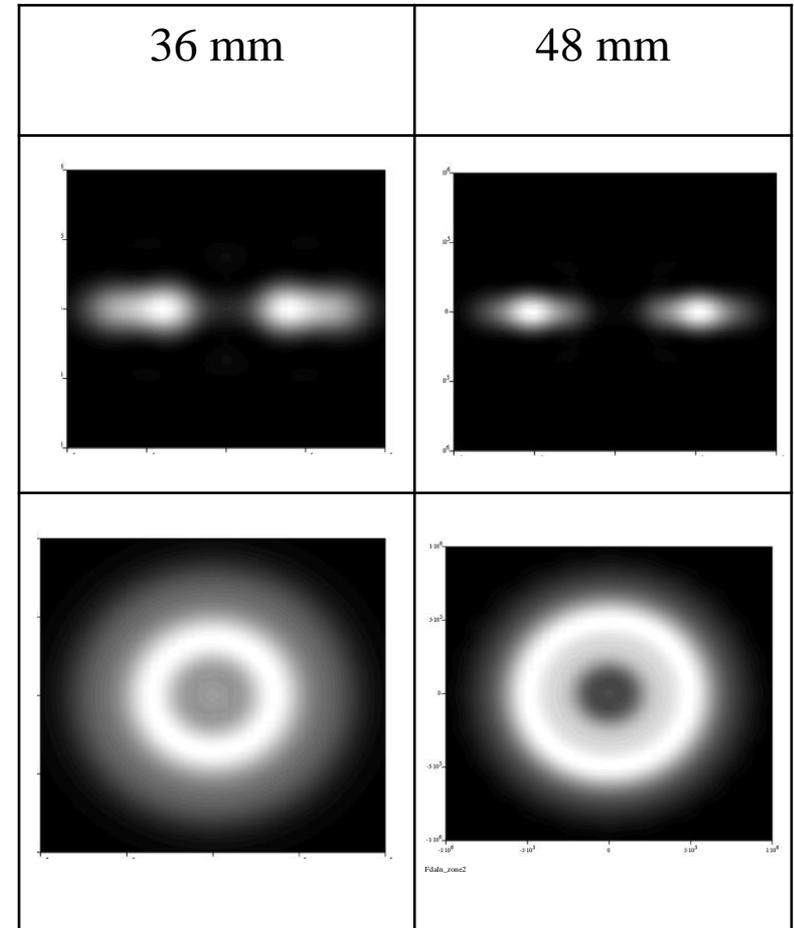
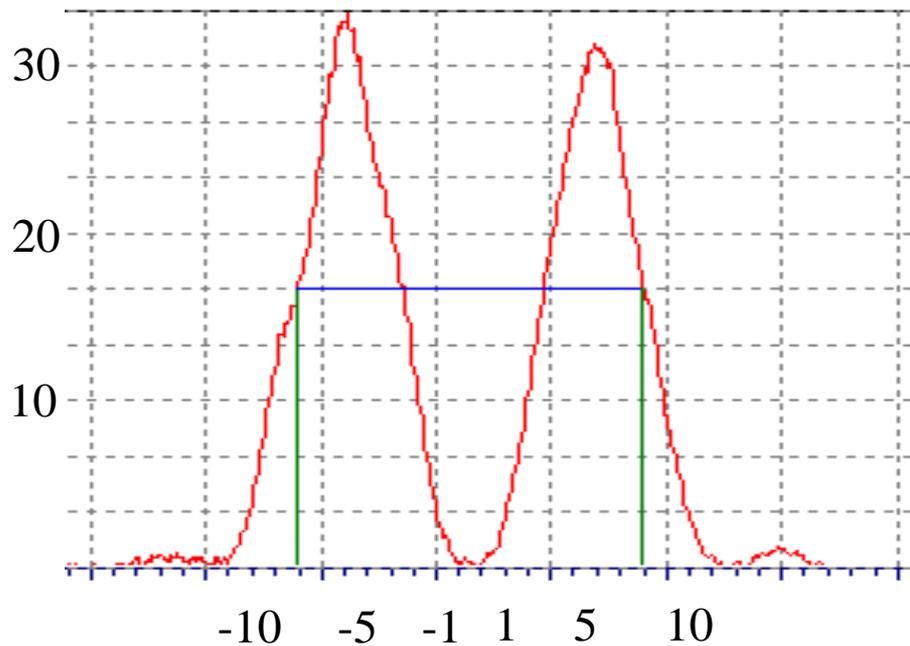


A choice of the CCR optimal size and the dihedral angle offset

$$\text{DAO} = 2,4'' \pm 0,2''$$



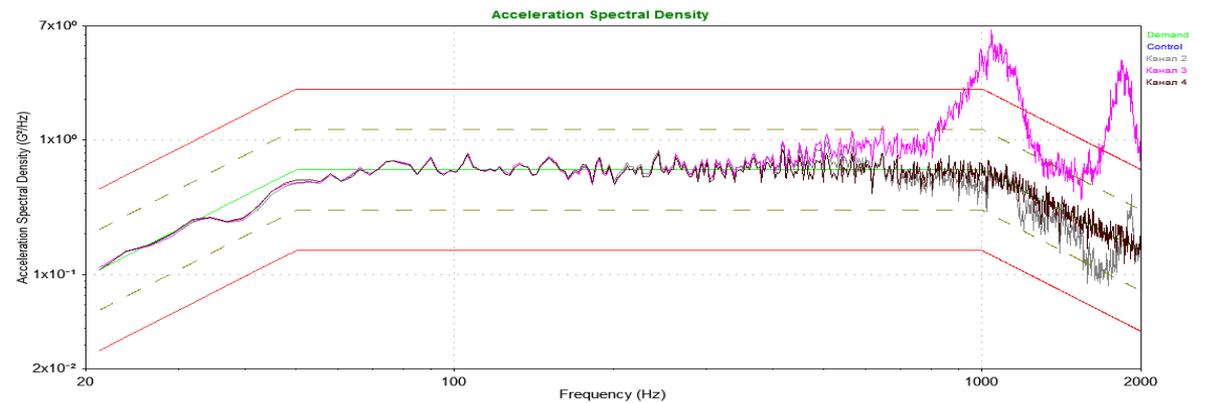
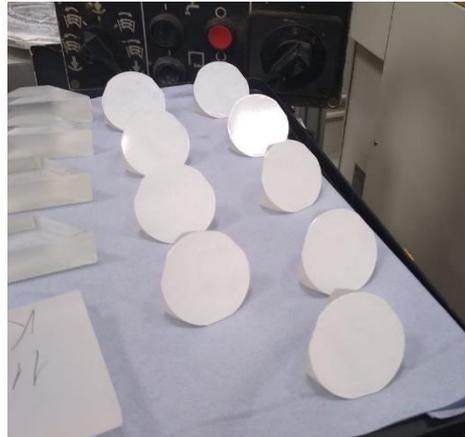
Cross-section (mln. m²)



Speed aberration angle (angl. sec.)



RRA production and testing



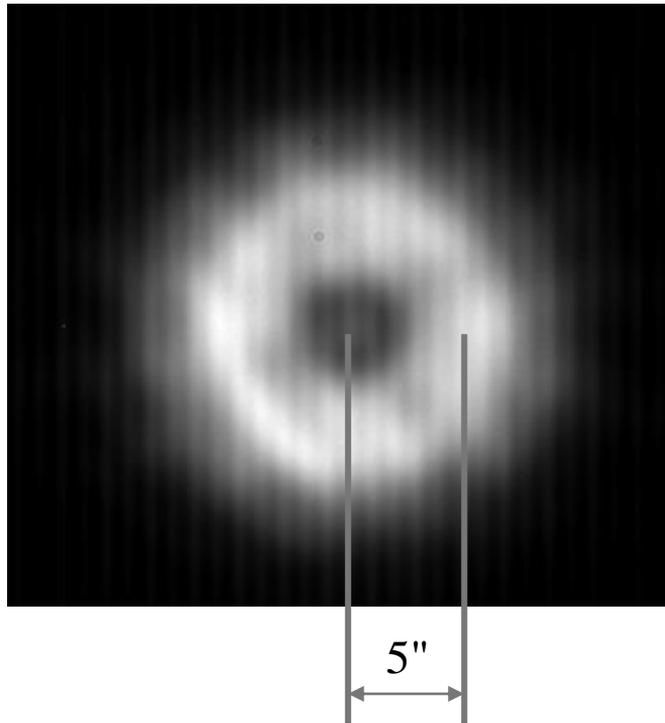
сен 16, 2019 14:07:37
Demand: 29,67 G RMS
Control: 29,67 G RMS

Level 1) 100 %
Level Time: 0:06:00
Total Time: 0:06:17

Output: 3,403 Volts RMS
Ч2=28,58 G RMS, Ч3=52,12 G RMS
Ч4=29,56 G RMS
End of Test
Перпендекулярно плоскости крепления



RRA parameters



CCR aperture	48 mm
Deviation (offset) of the dihedral angle from 90°	2,4''±0,2''
FFDP type	With two lobes
The number of CCR	36
One LRR mass (of all LRRs)	120 gr (4 300 gr)
Base mass	1 700 gr
Reflecting coating	Interference phaseshift
Cross section in the normal light incidence	about 180 mln. m ²
Production error of the base	0,1 mm
Temperature range	±100°C
Warranty period	15,5 years



1. Roscosmos has scheduled the Blits-M launch on 25 of December, 2019. The PSI Corporation now asks the ILRS to mobilize the global network of stations with the aim to provide support to the Blits-M mission.
2. RRA FFDP has a ring shape with a maximum at the angle distance, corresponding to the speed aberration value for SC "Glonass". In case of RRA in the LRS receiver two short impulses are formed instead of one broad impulse from the group of three CCRs on the opposite sides of RRA.
3. RMS of a single range measurement to the RRA center becomes equal to 8 mm instead of 40 – 70 mm, and, then, the array phase center is determined precisely during 30 second instead 300 s.
4. We create a new technology of the enlarged CCR production with the accuracy of two-facet angles production - 0,2 ang. sec.
5. A new mechanical frame is designed, which allows to set CCR into RRA with 0,1 mm accuracy.
6. The produced CCR and RRA have successfully passed through the vibrating and thermal vacuum tests.



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